TURNER DESIGNS

CYCLOPS

SUBMERSIBLE SENSORS

User's Manual

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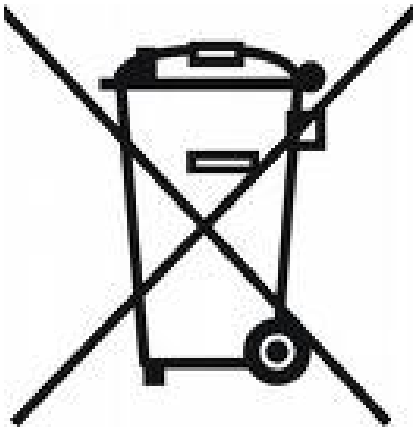


WASTE ELECTRICAL AND ELECTRONIC EQUIPMENT (WEEE) DIRECTIVE

Turner Designs is in the business of designing and selling products that benefit the well-being of our environment. Accordingly, we are concerned with preserving the surroundings wherever our instruments are used and happy to work with customers by complying with the WEEE Directive to reduce the environmental impact resulting from the use of our products.

WEEE Return Process:

To arrange the return of an end-of-life product, proceed as follows:

If you purchased your instrument through a Turner Designs Distributor please contact your local representative. They will instruct you where to return the end-of-life product.

If you purchased your instrument directly from Turner Designs please contact Turner Designs Customer Service
By Phone: 1-408-212-4041 or Toll Free: (877) 316.8049
By Email: Customer Service at support@turnerdesigns.com
Turner Designs will provide a WEEE RMA Number, a Shipping Account Number, and a Ship to Address. Package and ship the product back to Turner Designs.

The product will be dealt with per Turner Designs' end-of-life recycling program in an environmentally friendly way.

1. Introduction

1.1 Description

The Turner Designs' Cyclops Submersible Sensor is an accurate single-channel detector that can be used for many different applications. It is designed for integration into multi-parameter systems from which it receives power and delivers a voltage output proportional to the concentration of the fluorophore, particle, or compound of interest.

The Cyclops voltage output can be correlated to concentration values by calibrating with a standard of known concentration.

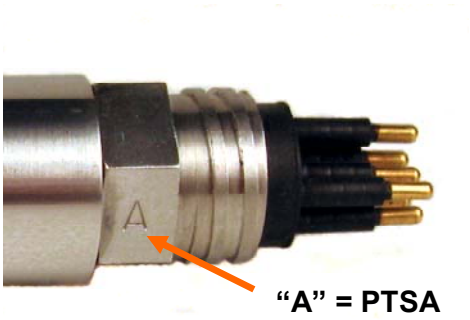
2. Inspection and Setup

2.1 Instrument Checklist

The Cyclops Submersible Sensor shipment package consists of:

- Cyclops Submersible Sensor:

  Configured and factory scaled for the specified analysis (see Identification Letter stamped on the connector for specified analysis):
  - "C" = Chlorophyll
  - "R" = Rhodamine
  - "F" = Fluorescein
  - "P" = Phycocyanin
  - "E" = Phycoerythrin
  - "U" = CDOM / fDOM
  - "O" = Crude Oil
  - "B" = Optical Brighteners
  - "T" = Turbidity
  - "G" = Refined Fuels
  - "A" = PTSA



- Cyclops Documentation Kit includes:
  - User's Manual
  - Quick Start Guide
  - *in vivo* Calibration Procedure
  - Cable Guide
- Calibration Certificate

2.2 Housing Configurations:

- Stainless Steel Cyclops-7 (P/N: 2100-000-"Identification Letter")
- Plastic or Titanium housings (recommended for highly corrosive environments or long term deployments).
  Titanium Cyclops-7 (P/N: 2100-000-"Identification Letter"T)
  Plastic Cyclops-7 (P/N: 2108-000-"Identification Letter")
  Plastic Cyclops-7 with Titanium connector (P/N: 2108-000-"Identification Letter"T)
- 6000 meter Cyclops-**6K (**P/N: 2160-000-"Identification Letter")

2.3 Optional Accessories include:

- Cyclops Pigtail Cables with Locking Sleeve *(see Appendix D for more information)*
  - 2 foot Pigtail Cable with Locking Sleeve (P/N 2100-750)
  - 5 meter Pigtail Cable with Locking Sleeve (P/N 2100-755)
  - 10 meter Pigtail Cable with Locking Sleeve (P/N 2100-751)
  - 25 meter Pigtail Cable with Locking Sleeve (P/N 2100-752)
  - 50 meter Pigtail Cable with Locking Sleeve (P/N 2100-753)

- DataBank Handheld Data Logger *(see Appendix K)* (P/N 2900-000)
- Flow Cap *(see Appendix I for more information)*
  - Cyclops-7 Stainless Steel and Titanium (P/N 2100-600)
  - Cyclops-7 Plastic (P/N 2100-608)
  - Cyclops-**6K** (P/N 2160-600)
- Shade Cap *(see Appendix H for more information)*
  - Cyclops-7 Stainless Steel and Titanium (P/N 2100-701)
  - Cyclops-7 Plastic (P/N 2100-708)
  - Cyclops-**6K** (P/N 2160-700)
- Solid Secondary Standard (SSS) for *in vivo* Chlorophyll, Phycocyanin, Phycoerythrin, Rhodamine, Fluorescein *(see Appendix J for more information)*
  - Cyclops-7 Stainless Steel and Titanium (P/N 2100-900)
  - Cyclops-7 Plastic (P/N 2100-908)
  - Cyclops-**6K** (P/N 2160-900)
- Solid Secondary Standard (SSS) for UV Sensors (CDOM / fDOM, Optical Brighteners, Refined Fuels and Crude Oil) *(see Appendix J for more information)*
  - Cyclops-7 Stainless Steel and Titanium (P/N 2100-904)
  - Cyclops-7 Plastic (P/N 2100-905)
  - Cyclops-**6K** (P/N 2160-901)

Solid Secondary Standard

Shade Cap

Flow Cap

2.4 Functional Test

To perform a functional check on the Cyclops, connect the interface colored wires to the power supply and multi-meter as shown in Figure 1 below.

Additional Equipment required for functional tests:
DC Power Supply, 3 - 15 VDC, >100 mA
Multi-meter to read 0 – 5 VDC

Note: Supply voltages greater than 15 VDC will result in damage to the sensor.

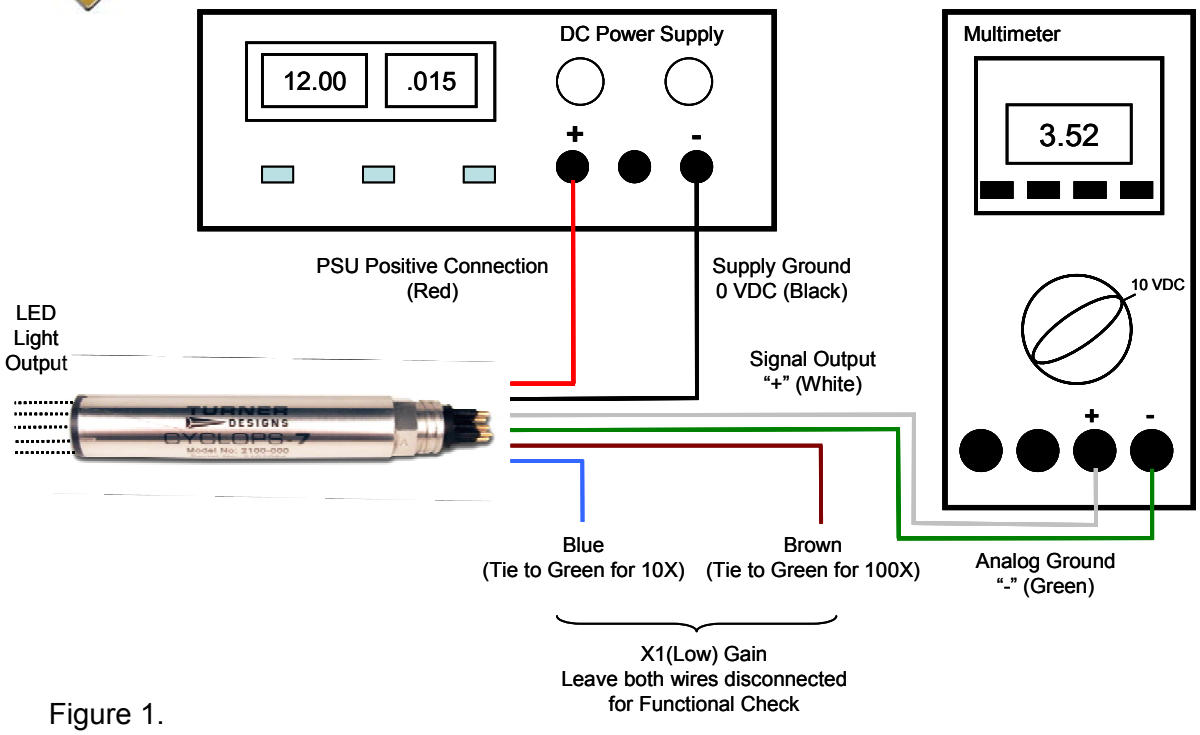


Figure 1.

With the Cyclops connected as shown in Figure 1 answer questions 1-3 by making the following functional tests:

1. Is the LED on?
   Hold a piece of white paper about ½ an inch in-front of the optical head to ensure the LED is on. ***Note: Cannot perform this test for Turbidity sensors because they use IR which is not visible.***

2. Is there voltage output?
   The multi-meter should be reading some voltage >0 VDC

3. Does the voltage output change?
   Move the light source closer to your hand or a surface and check if the voltage output increases

3. Measurements with the Cyclops

3.1 Introduction

The following information will describe how to:

- Determine and set the appropriate gain
- Calibrate the Cyclops using standards with known concentrations
- Make measurements with the Cyclops
- Use the Solid Secondary Standard

Note: To make accurate and repeatable measurements it is important to keep the sensor clean; see section 5.1 for information on cleaning your sensor.

3.2 Setting the Gain

Gain setting refers to the sensitivity configuration of the sensor. There are three gain settings; X1, X10 and X100. As the gain increases, the sensitivity increases and the concentration range decreases.

3.2.1 Gain Determination Procedure

1) For *in vivo* applications, take a natural sample of water from a sampling station where you plan to deploy the Cyclops. Applying good measurement practices, store it properly and quickly transport it to a laboratory where you have the Cyclops connected to a multi meter and DC power source *(see Figure 1)*.

2) Pour the water sample into a clean glass beaker and submerge the optical end of the Cyclops *(see Appendix B for "Recommended Measurement Practices for using your Cyclops in the Lab" for how best to accomplish these steps)*.

3) Activate the X10 gain setting *(see Wiring Guide Appendix C)* if you believe the sample to represent a typical condition. You would like to obtain a signal from the sample that is significantly higher than a blank sample (de-ionized water or filtered seawater), but not a signal that is close to the maximum of 5 Volts.

4) If the sample signal is high, (>3.0 V for example) you may choose to use the X1 gain instead of the X10 gain setting so that you avoid going over scale once you deploy the Cyclops.

5) If the sample signal is very low (<0.3V) you may choose to use the X100 gain setting to achieve higher sensitivity but a smaller measurable range

This process is easier for dye tracing applications. Simply create the dye dilution of interest and record what signal level it provides on the three gain settings.

3.2.2 Static Gain Control

If integrating into a multi parameter system or data logger that is set up for "Static Gain Control", which refers to the use of only one gain setting at a time, then you must determine which gain to use prior to deployment (see section 3.2.1) and have an integration cable made to activate that specific gain *(see Appendix C)*. For most applications the X10 gain will provide the best sensitivity, range, and resolution.

Customers wanting to dynamically change the gain ranges to achieve the optimum operating range should refer to "Method 2 – Dynamic Gain Control" in *Appendix F* on how to interface with a Data Collection System with programmable outputs.

3.2.3 Auto Gaining

Certain data loggers or multi parameter systems will have an auto gaining feature which will automatically adjust the sensitivity according to the voltage output from the Cyclops sensor. This feature maximizes the performance of Cyclops sensors allowing users to detect a broad range of concentrations, obtain the best resolution, and read minimum detection limits without having to rewire or manually change the sensor's sensitivity. Turner Designs manufactures the DataBank Handheld Data Logger *(see Appendix K)* which has the auto gain feature and other functions that maximize the performance of Cyclops sensors.

3.3 Direct Concentration Calibration

Calibrating the Cyclops is a simple process requiring the use of calibration standards. The Cyclops can be calibrated using a single calibration standard which correlates the standard's concentration to the voltage measured for that specific standard:

1) Connect the Cyclops to a power source and set the Cyclops to a gain setting *(see section 3.2.1 for explanation on how to determine gain)*

2) Measure the voltage from a blank sample for the configured gain setting. ***Note: A good blank to use for this application is ultra pure or deionized water.***

3) Use a standard of known concentration and create a correlation between the standard's concentration and its voltage output

4) Once a correlation has been made, use the following equation to calculate concentration values for sample measurements for the calibrated gain:

$C_{Sample} = [(C_{Std})/(Volts_{Std} - Volts_{Blank})] * (Volts_{Sample} – Volts_{Blank})$

C_{Std} = Concentration value of standard used for calibration
C_{sample} = Concentration of sample
$Volts_{Std}$ = Voltage reading from standard concentration
$Volts_{Sample}$= Voltage reading from sample(s)
$Volts_{Blank}$ = Voltage reading from blank

4. Turbidity Cyclops

4.1 Introduction

The Turbidity Cyclops measures turbidity using an 850nm light source and detection of scattered light at a 90-degree angle which is similar to many modern day bench top turbidity meters. This unit provides a quick and accurate way to determine *in situ* turbidity, eliminating the collection and storage of samples and minimizing the potential error associated with sample handling and processing.

4.2 Calibration

Calibrating the Turbidity Cyclops is a simple process requiring the use of calibration standards. Turner Designs recommends purchasing Amco Clear Analytical Turbidity Standards for non-ratio instruments because these standards are non-toxic safe solutions consisting mainly of deionized water that comes prepared in a broad range of concentrations and has a shelf life guaranteed for one year. The Turbidity Cyclops can be calibrated using a single calibration standard which correlates the concentration to the voltage measured for that specific standard:

1) Connect the Turbidity Cyclops to a power source and set the Turbidity Cyclops to a gain setting *(see "Setting the Gain" section 3.2 for explanation on how to set the gain)*

2) Measure the voltage from a blank sample for the configured gain setting. ***Note: A good blank to use for this application is ultra pure or deionized water.***

3) Use a turbidity standard of known concentration (NTU) and create a correlation between the standard (NTU) and its voltage output

4) Once a correlation has been made, use the following equation to calculate turbidity values for sample measurements for the calibrated gain:

$$NTU_{Sample} = [(NTU_{Std})/(Volts_{Std} - Volts_{Blank})] * (Volts_{Sample} - Volts_{Blank})$$

NTU_{Std} = Concentration value of standard used for calibration
NTU_{Sample} = Concentration of sample
$Volts_{Std}$ = Voltage reading from standard concentration
$Volts_{Sample}$= Voltage reading from sample(s)
$Volts_{Blank}$ = Voltage reading from blank

5. Maintenance and Warranty

5.1 Maintenance

5.1.1 Rinsing

The Cyclops should be rinsed or soaked in fresh water following each deployment, ideally until it is completely clean again.

5.1.2 Care for the bulkhead connector

A light coat of Silicone spray should be used on the rubber of the male pins of the bulkhead to aid in sealing. The manufacturer recommends 3M™ Silicone Lubricant Spray or Loctite 8021 spray. ***Note: You should avoid using silicone grease. Do NOT use WD-40, it will destroy the connectors.***

5.1.3 Care for the optics

The optical window should be visually inspected after each deployment following a soaking in fresh water. If cleaning is needed, use optical tissue to clean the window with soapy water.

Note: The Cyclops should NOT come in contact with any organic solvents (i.e. acetone, methanol) or strong acids and bases.

The UV Cyclops models are the **ONLY** Cyclops sensors that can be calibrated with Quinine Sulfate standards made in Hydrosulfuric Acid. All other Cyclops models **CANNOT** be used in Hydrosulfuric Acid.

5.2 Warranty Terms

Turner Designs warrants the Cyclops and accessories to be free from defects in materials and workmanship under normal use and service for a period of 12 months from the date of shipment from Turner Designs with the following restrictions:

- Turner Designs is not responsible for replacing parts damaged by accident or neglect. Your instrument must be installed according to instructions in the User's Manual. Damage from corrosion is not covered. Damage caused by customer modification of the instrument is not covered.

- This warranty covers only Turner Designs products and is not extended to equipment used with our products. We are not responsible for accidental or consequential damages, except in those states where this limitation is not allowed. This warranty gives you specific legal rights and you may have other rights which vary from state to state.

- Damage incurred in shipping is not covered.

5.3 Warranty Service

To obtain service during the warranty period, the owner shall take the following steps:

1. Write, email or call Turner Designs Technical Support and describe as precisely as possible the nature of the problem.

   Phone: 1 (877) 316-8049
   Email: support@turnerdesigns.com

2. Carry out any adjustments or tests as suggested by Technical Support.

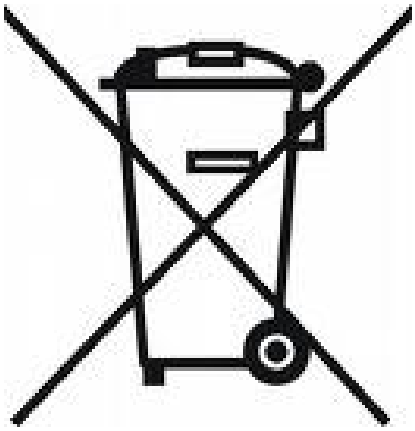
3. If proper performance is not obtained you will be issued a Return Materials Authorization number (RMA) to reference. Package the unit, write the RMA number on the outside of the shipping carton, and ship the instrument, prepaid, to Turner Designs. If the failure is covered under the warranty terms the instrument will be repaired and returned free of charge, for all customers in the contiguous continental United States.

   For customers outside of the contiguous continental United States who purchased equipment from one of our authorized distributors, contact the distributor. If you purchased directly, contact us. We will repair the instrument at no charge. Customer pays for shipping, duties, and documentation to Turner Designs. Turner Designs pays for return shipment (custom duties, taxes and fees are the responsibility of the customer).

5.4 Out-of-Warranty Service

Follow steps for Warranty Service as listed above. If Technical Support can assist you by phone or correspondence, we will be glad to, at no charge. Repair service will be billed on a fixed price basis, plus any applicable duties and/or taxes. Shipment to Turner Designs should be prepaid. Your bill will include return shipment freight charges.

Address for Shipment:
Turner Designs, Inc.
845 W. Maude Ave.
Sunnyvale, CA 94085



Appendix A: Specifications

Parameter	Specification
Linearity (full range)	0.99 R^2
Power Draw	@ 3V: Max 360 mW ≥ 5V: Max 265 mW
Input Voltage	3 – 15 VDC
Signal Output	0 – 5 VDC Analog
Temperature Range	Ambient: 0 to 50 °C Water Temp: -2 to +50 °C
Light Source	Light Emitting Diode
Excitation Wavelength	Visible – Chl, RWT, PC, PE, F UV – CDOM / fDOM, Oil, OB, RF, PTSA IR – Turbidity
Detector	Photodiode
Detection Wavelength	300 – 1100 nm
Warm up time	5 seconds
Housing Material - Cyclops-7	(Standard) 316 Stainless Steel (Optional) Titanium (Optional) Plastic
Housing Material - Cyclops-**6K**	Titanium
Dimensions - Cyclops-7	Stainless Steel and Titanium L: 4.3 in., 10.9 cm; D: 0.875 in., 2.22 cm
	Plastic L: 4.3 in., 10.9 cm; D: 1.25 in., 3.175 cm
Dimensions - Cyclops-**6K**	L: 6.6 in, 6.76 cm; D: 1.75 in, 4.45 cm
Depth Rating - Cyclops-7	600 meters
Depth Rating - Cyclops-**6K**	6000 meters
Weight - Cyclops-7	5 oz; 160 gm
Weight - Cyclops-**6K**	22 oz; 620 gm

Appendix B: Recommended Measurement Practices

Recommended Lab Practices for Measurements

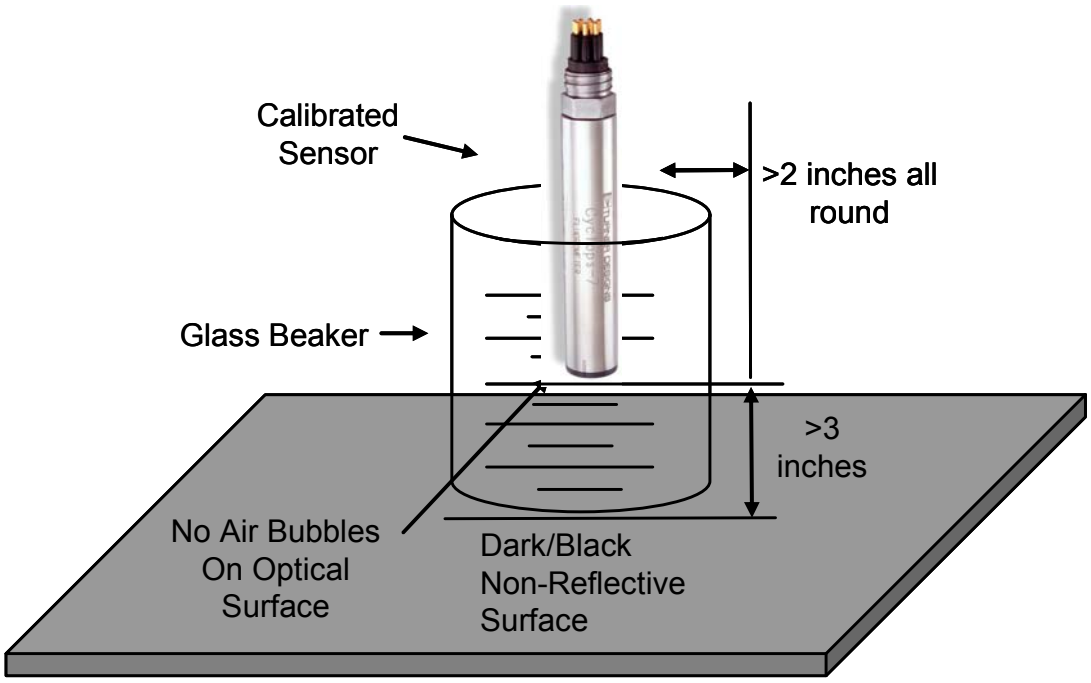
The following steps will improve the accuracy and repeatability of your measurements, especially at low concentration levels:

1. Use a non-fluorescent container for your water samples. ***Note: Plastic may fluoresce and interfere with the sample's fluorescence.***

2. If using a glass container, place the container on a non-reflective black surface.

3. Ensure that the sensor is more than 3 inches above the bottom of the container.

4. Ensure that the sensor is in the center of the container and has more than 2 inches clearance between the cirumference of the sensor and the inside surface of the beaker.



Appendix C: Wiring Guide

Cyclops-7 Wire	Pin Number	Function	Connection
Red	1	Supply Voltage 3 – 15 VDC	PSU – Positive Connection
Black	2	Supply Ground, 0VDC	PSU – Ground Connection
White	3	Signal Out to data logger "+" 0 – 5VDC	Multimeter Positive Connection
Green	4	Analog Ground "-", 0 VDC	Multimeter Negative Connection
Blue	5	X10 Gain, (Medium Sensitivity)	See table below
Brown	6	X100 Gain, (High Sensitivity)	See table below

Gain Switching Table

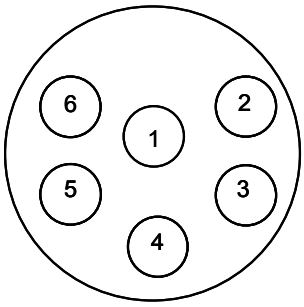
Gain 10 (Blue)	Gain 100 (Brown)	Gain	Chl Range (μg/L)	RWT Range (ppb)	TRB Range (NTU)
Not connected	Not connected	X 1	0 - 500	0 – 1,000	0-3000
Connected to analog ground	Not connected	X 10	0 – 50	0 - 100	0-1000
Not connected	Connected to analog ground	X 100	0 – 5	0 - 10	0-100

Appendix D: Cable Guide

Cyclops Pigtail Cable with Locking Sleeve

- 2 foot Pigtail Cable with Locking Sleeve (P/N 2100-750) shown
- 5 Meter Pigtail Cable with Locking Sleeve (P/N 2100-755)
- 10 Meter Pigtail Cable with Locking Sleeve (P/N 2100-751)
- 25 Meter Pigtail Cable with Locking Sleeve (P/N 2100-752)
- 50 Meter Pigtail Cable with Locking Sleeve (P/N 2100-753)

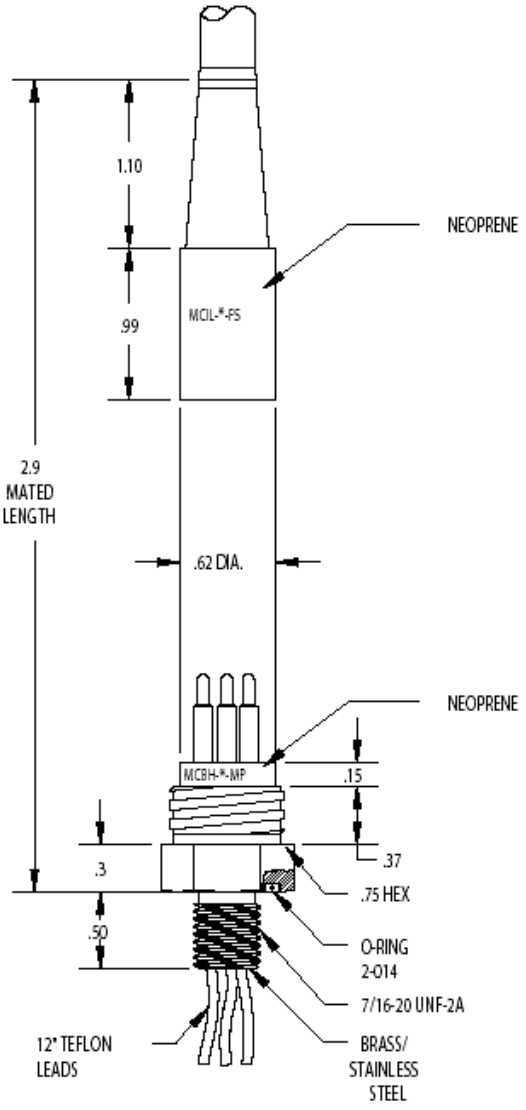
Any of the cables listed above may be used to operate the Cyclops.

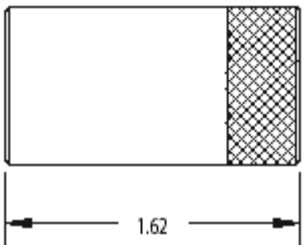


Color	Pin	Function	Connection
Red	1	Supply Voltage 3-15 VDC	PSU – Positive Connection
Black	2	Supply Ground 0 VDC	PSU – Ground Connection
White	3	Signal Out to data logger, “+”, 0-5 VDC	Positive Connection
Green	4	Analog Ground, “-”, 0 VDC	Negative Connection – Analog Ground
Blue	5	x10 Gain, Medium Sensitivity	Analog Ground - Blue tied to Green
Brown	6	x100 Gain, High Sensitivity	Analog Ground - Brown tied to Green

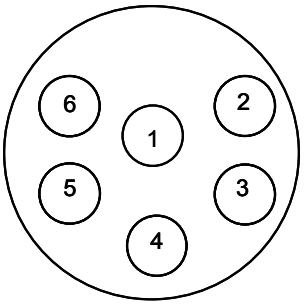
Appendix E: Pigtail Cable and Connector Information

Dimension details of 24” length cable with 20 gauge colored lead wire, connects to 6 pin male connector. (Cable manufacturer/Part No: IMPULSE/MCIL-6-FS)





Female locking sleeve, (Impulse P/No. MCDLS-F)



In-line connector contact configuration (connects to Cyclops).

A maximum cable length up to 300 meters can be connected to the Cyclops if the following conditions are met:

1) The cable is shielded and contains 20 gauge conductor size or greater (i.e. Beldon No. 8426 cable).
2) The 0-5 volt Analog output is connected to a device (i.e. Data Logger) with an input impedance of 1 MegOhm or greater.
3) The supply Voltage to the Cyclops is between 5 and 15 volts.

Appendix F: Controlling the Gain

The operating range can either be set to one of the 3 available ranges, which will be referred to as "Static Gain Control", or it can be dynamically changed to achieve the optimum operating range, referred to below as "Dynamic Gain Control". The first approach is applicable when using the Cyclops as a stand-alone sensor. The second approach is applicable when the Cyclops is integrated into a system with control capability.
Both methods are implemented by grounding “driving Low” the appropriate gain control pin. The X10 and X100 gain control pins are normally in a "High" state if they are not connected to anything. This means the Cyclops default is the X1 gain (largest concentration range) mode. The Cyclops can be put into higher gain, lower concentration range modes, by connecting either the X10 or X100 pin **(but not both at the same time)** to ground.

Method 1 - Static Gain Control

Connect the X10 or X100 pin to the analog ground pin of the Cyclops pigtail connector. See the Gain Switching Table in Appendix C to determine the required configuration for desired gain/measurement range. See Appendix E for Pigtail Cable and Connector information. Also, see “Setting the Gain” section 3.2 for more information on “Static Gain Control”.

Method 2 - Dynamic Gain Control

If you have a Data Collection System (DCS) that has programmable outputs you can use them to control the Cyclops gain settings. Following are three common output types found in DCSs and how to connect them to the Cyclops. Refer to your DCS manual to determine which is appropriate. (For those who want technical data: the Cyclops’s X10 and X100 gain control pins are connected internally to the input of a Schmitt trigger inverter, part number 74LVC1G14, and a 100K ohm pull-up resistor. Both use a 5-Volt power supply.)

Output type 1: Digital Signals

Logic signals can be used to drive the gain control pins. In most cases you can connect the digital signal output of the DCS directly to the Cyclops gain control pins. To drive them high, the voltage should be 3 VDC min – 5 VDC max. To drive them low, the voltage should be 1 VDC max – 0 VDC min. You may need to connect the Cyclops analog ground to the DCS ground.

Output type 2: Open Collector Signals

This type of output is either open or connected to ground. Connect the Cyclops gain control pins directly to these outputs. You may need to connect the Cyclops analog ground to the DCS ground.

Output type 3: Relays

Relays act as a controllable switch. Connect one end of the relay to the Cyclops analog ground. Connect the other end of the relay to the Cyclops gain control pin.

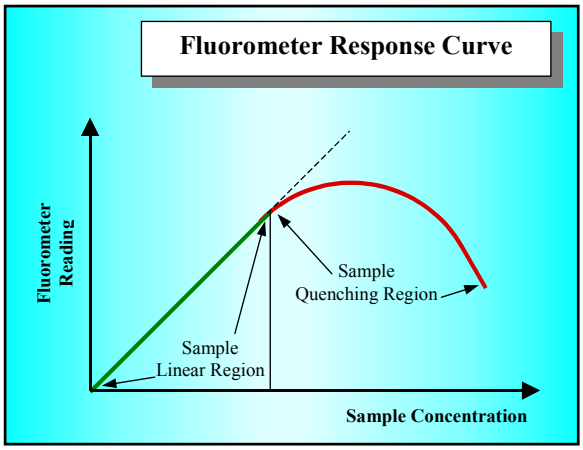
Appendix G: Linear Range, Quenching and Temperature Considerations

The linear range is the concentration range in which the fluorometer's output is directly proportional to the concentration of the signal. The linear range begins with the smallest detectable concentration and spans to an upper limit (concentration) that is dependent upon the properties of the material, filters used, and path length.

A non-linear relationship is seen at very high concentrations where the signal does not increase at a constant rate in comparison to the change in concentration (see figure below). At even higher concentrations, the signal will decrease even though the sample concentrations are continuing to increase. This effect is known as "signal quenching".

Linearity can be checked by diluting a sample 1:1 or some other convenient ratio. If the sample is still in the linear range, the reading will decrease in direct proportion to the dilution. If the reading does not decrease in direct proportion to the dilution, or if the reading increases, the sample is beyond the linear range.

Temperature Considerations



Graph showing Linear and Quenching Regions of the sample's response

Fluorescence is temperature sensitive. As the temperature of the sample increases, the fluorescence decreases. For greatest accuracy, record the sample temperature and correct the sensor output for changes in temperature.

For further information on how temperature, light, water quality and the physiological state of the algal cells can all affect the measurement of chlorophyll, please refer to the application section of Turner Designs' website.

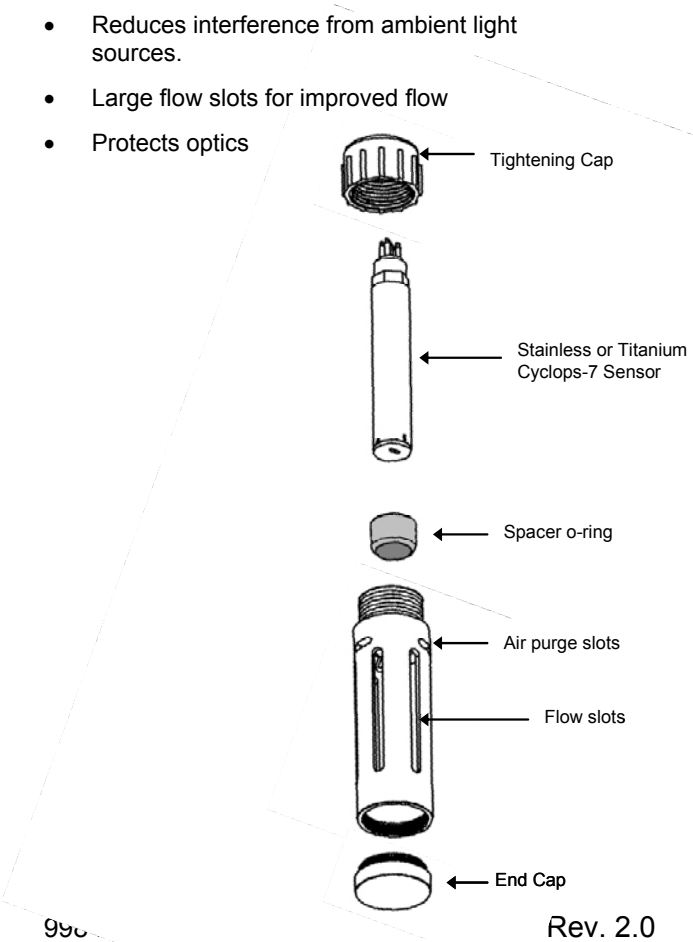
Appendix H: Installing the Shade Cap

Introduction

The Shade Cap (P/N: 2100-701) for the **Stainless or Titanium** Cyclops-7 Sensor offers protection for the optics located at the optical end of the instrument. It prevents damage from deploying, recovering, or transporting the instrument in fast-flowing environments, and/or from bottoming out in shallow environments. The Shade Cap also helps block other possible sources of light that may interfere with the Cyclops-7 Sensor's measurements.

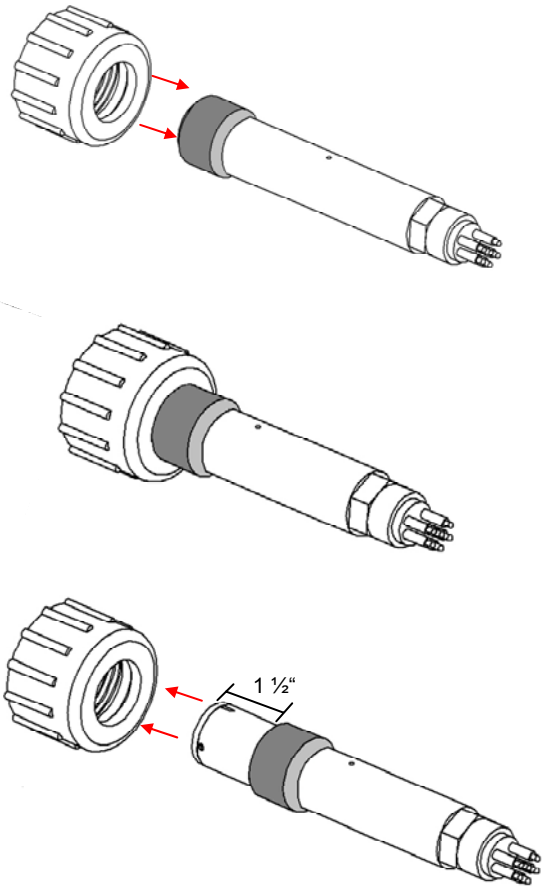
Features

- Corrosion-resistant material
- Reduces interference from ambient light sources.
- Large flow slots for improved flow
- Protects optics

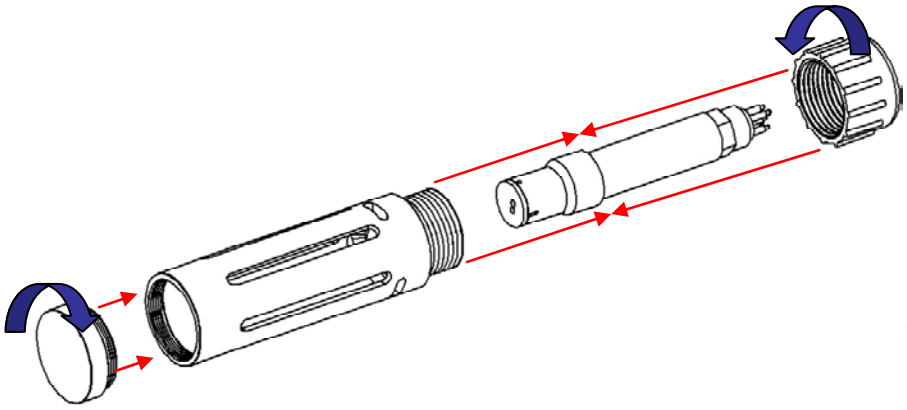


Installation

1. Install the Spacer o-ring approximately 1 ½" from the optical end of the Cyclops-7. The o-ring is intended to fit very tightly on the Cyclops-7 and can be difficult to install. You can use the Tightening Cap to help slide the o-ring on. Soapy water can be used to lubricate the o-ring, but it should be rinsed off and dried once the o-ring is in place.



2. Slide the Tightening Cap on from the plug end of the Cyclops-7 and the Shade Cap from the optical end of the Cyclops-7 as shown below, positioning the threads over the o-ring. Turning clockwise, hand tighten the Tightening cap onto the Shade Cap. The Shade Cap is installed correctly if the optic end of the Cyclops-7 is flush with the interior base of the Shade Cap.



3. (Optional) Turning clockwise, hand tighten the End Cap to the other end of the Shade Cap until it is fully secured to the Shade Cap. The End Cap prevents sediment and other debris from entering the shade cap.

Shade Cap Specifications

Material	Delrin and PVC
Weight	110 g (0.24 lbs.)
Length	12.7 cm (5.0 in.)
Diameter	4.3 cm (1.7 in.)
Depth Rating	600 meters

Cyclops Submersible Sensor

Introduction

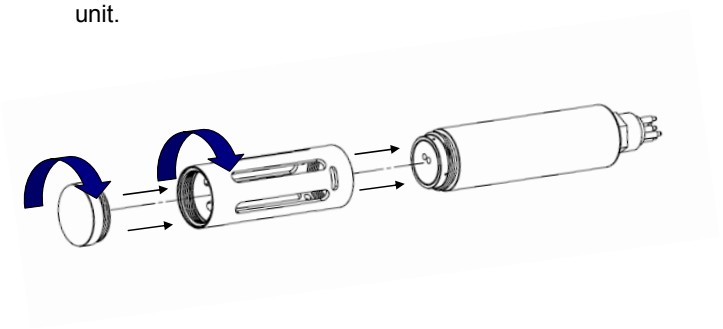
The Shade Cap (P/N: 2100-708) for the **Plastic** Cyclops-7 Sensor offers protection for the optics located at the optical end of the instrument. It prevents damage from deploying, recovering, or transporting the instrument, in fast-flowing environments, and/or from bottoming out in shallow environments. The Shade Cap also helps block other possible sources of light that may interfere with the Plastic Cyclops-7 Sensor's measurements.

Features

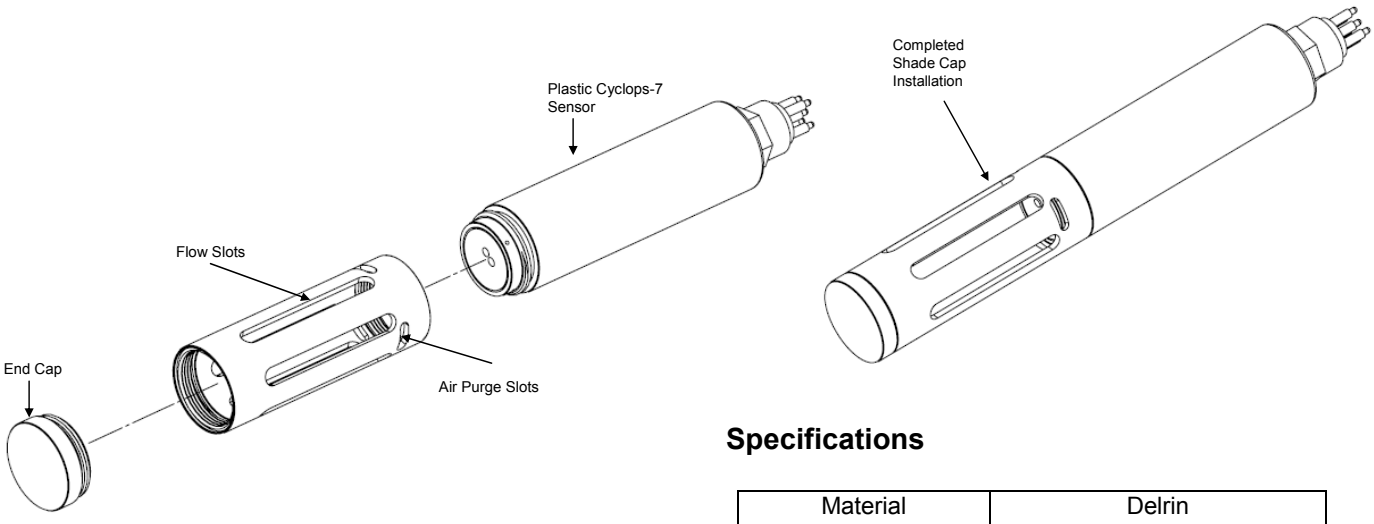
- Threaded ends for easy installation and removal
- Corrosion-resistant material
- In-line design maintains sensor's diameter
- Large flow slots for improved flow

Installation

1. Turning clockwise, hand tighten the air purge slot end of the Shade Cap onto the Plastic Cyclops-7 Sensor's optical head until the Shade Cap is fully secured to the unit.



2. Turning clockwise, hand tighten the End Cap to the other end of the Shade Cap until it is fully secured to the Shade Cap (Optional).



Specifications

Material	Delrin
Weight	22.9 g (0.05 lbs.)
Length	9.2 cm (3.62 in.)
Diameter	3.1 cm (1.22 in.)
Depth Rating	600 meters

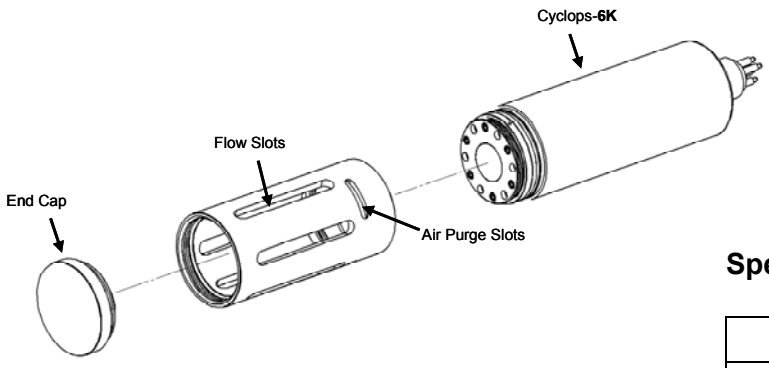
Cyclops Submersible Sensor

Introduction

The Cyclops-**6K** Shade Cap (P/N: 2160-700) offers protection for the optics located at the optical end of the instrument. It prevents damage from deploying, recovering, or transporting the instrument in fast-flowing environments, and/or from bottoming out in shallow environments. The Shade Cap also helps block other possible sources of light that may interfere with the Cyclops-**6K** Sensor's measurements.

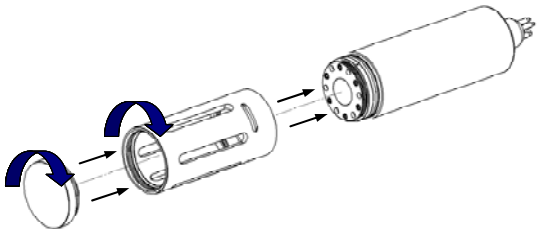
Features

- Threaded ends for easy installation and removal
- Corrosion-resistant material
- In-line design maintains sensor's diameter
- Large flow slots

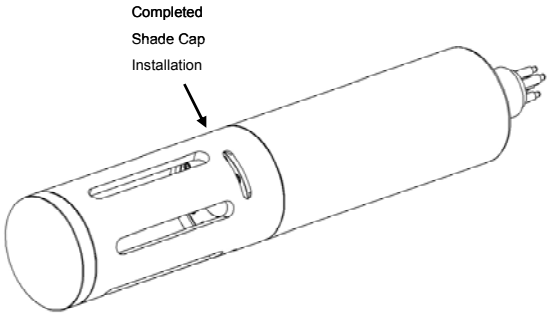


Installation

1. Turning clockwise, hand tighten the air purge slot end of the Shade Cap onto the Cyclops-**6K** Sensor's optical head until the Shade Cap is fully secured to the unit.



2. Turning clockwise, hand tighten the End Cap to the other end of the Shade Cap until it is fully secured to the Shade Cap (Optional).



Specifications

Material	Delrin
Weight	50.0 g (0.11 lbs.)
Length	9.8 cm (3.86 in.)
Diameter	4.4 cm (1.74 in.)
Depth Rating	6000 meters

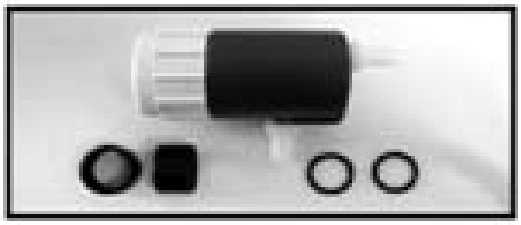
Appendix I: Installing the Flowthrough Cap

Introduction

The **Stainless or Titanium** Cyclops-7 Flowthrough Cap (P/N 2100-600) was designed for use with *in situ* instrument packages that utilize a submersible pump for flow through sampling. The Flowthrough Cap should not be subjected to a pressurized water source that will exceed 50 PSI of differential pressure. When using the Flowthrough Cap, best results will be obtained using the X1 or X10 Gain Ranges of the Cyclops-7 sensor

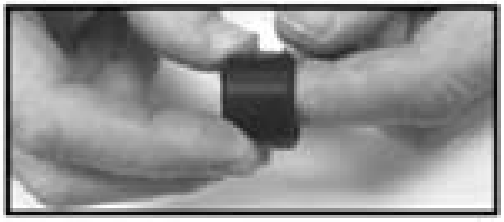
The Cyclops-7 Flowthrough Cap consists of the following components:

- 1 ea Flowthrough Cap
- 3 ea Compression Gaskets (1 installed, 2 spares)
- 3 ea O-Rings, (1 installed, 2 spares)

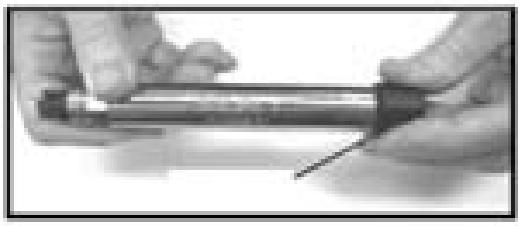


Assembly Procedure

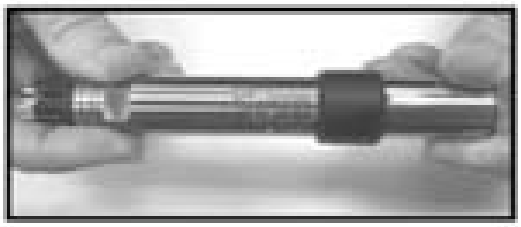
1. Lightly smear soapy water on the inside of the compression gasket.



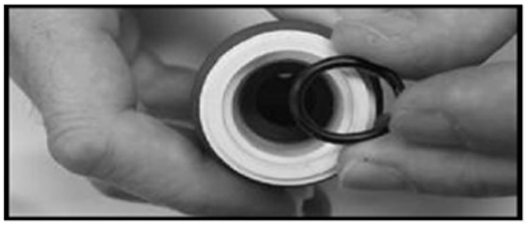
2. Slide the compression gasket over the optical end of the sensor with the “step” on the gasket towards the connection pins end of Cyclops-7.



3. Position the compression gasket approx. 2 inches from the optical end of the sensor



4. It is important to check that the O-Ring installed in the Flowthrough Body Assembly is squarely seated on the bottom of the cap. (It acts as a washer between the sensor and the cap). It is possible to damage the optical face of Cyclops-7 if this O-Ring is not in place.



5. Insert the optical end of Cyclops-7 in the Flowthrough Body Assembly. With the Cyclops-7 fully inserted into the cap, slide the compression gasket towards the optical end until it bottoms out inside the cap.

6. Place threaded end cap over the Cyclops-7 sensor, and screw down tightly by hand, (do not use tools to tighten).

Cyclops Submersible Sensor

Summary

The sensor and flowthrough cap are now ready for use.

Once installed, the Cyclops-7 sensor should be oriented such that the flow through cap is facing up. This orientation will prevent bubbles from collecting on the optics.

The inlet and outlet ports of the cap accept 3/8” ID tubing. The inlet tubing should be connected to the side-port on the cap and the outlet tubing connected to the top-port.

Note: With the Flowthrough Cap installed, the blank offset for the sensor will be elevated. If you are interested in measuring the offset increase, DI water can be used to measure the blank before and after the cap installation.

Application Note

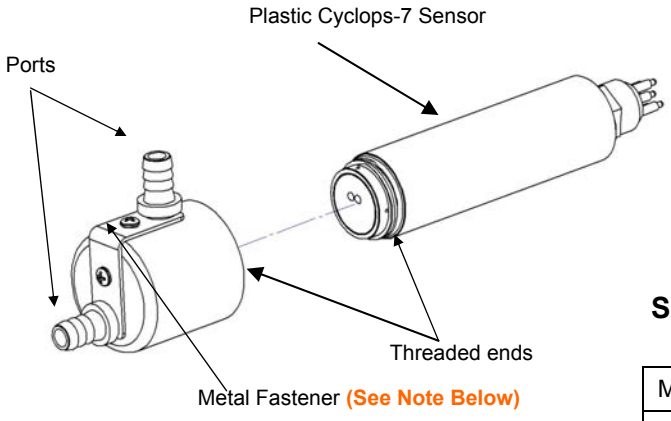
For Rhodamine WT applications, use high-density tubing to prevent absorption of the dye into the tubing. The Cyclops-7 should not come in contact with any organic solvents (i.e. acetone, methanol), or strong acids and bases.

Introduction

The Flowthrough Cap (P/N: 2100-608) for the **Plastic** Cyclops-7 Sensor was designed to enable flow through mode. The Flowthrough Cap will allow the Plastic Cyclops-7 Sensor to be configured with other instruments used in flow through systems.

Features

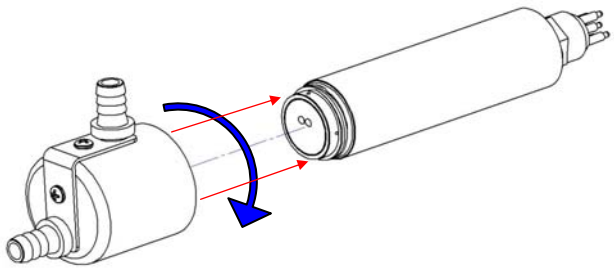
- Facilitates Flow-through sampling
- Eliminates other light sources that may interfere with sensor measurements
- Protects sensors from damage during deployment or transport
- Helps limit biofouling
- Corrosion-resistant plastic material
- Threaded end for easy installation and removal



Note: The Metal Fastener secures the ports to the Flowthrough Cap's housing. It should never be removed or tampered with. Doing so may result in damage to the Flow Cap ports and cause injury to yourself or others during operation.

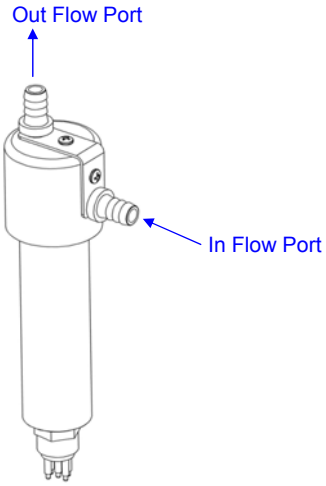
Installation Instructions

1) Turning clockwise, fully hand tighten the Flowthrough Cap housing onto the Plastic Cyclops-7 Sensor.



2) Flowthrough Cap installation is complete.

NOTE: For optimal use, Turner Designs recommends positioning or mounting the Plastic Cyclops-7 Sensor with* Flowthrough Cap *vertically. This will purge any air from the system that might cause skewed readings.



Specifications

Max. Pressure	50 psi
Length (w/ port)	6.4 cm (2.52 in.)
Diameter (w/ port)	6.7 cm (2.64 in.)
Weight	92.2 g (0.203 lbs.)
Max. Volume	5.00 ml
Material	Delrin

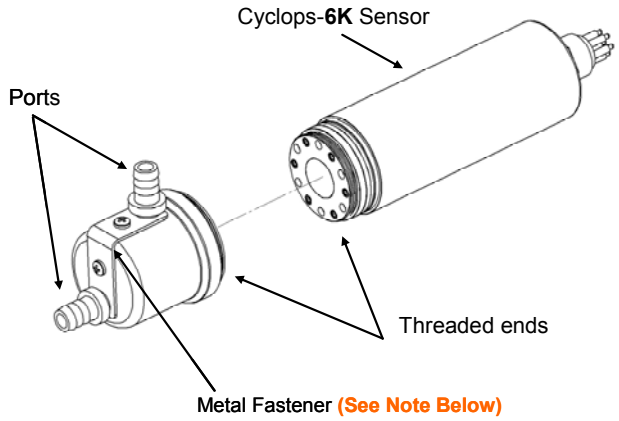
Cyclops Submersible Sensor

Introduction

The Flowthrough Cap (P/N: 2160-600) for the Cyclops-**6K** is designed to enable flow through mode. The Flowthrough Cap allows the Cyclops-**6K** Sensor to be configured with other instruments used in flow through systems.

Features

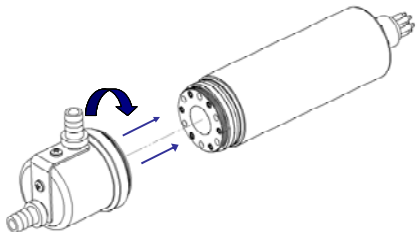
- Facilitates Flow-through sampling
- Eliminates other light sources that may interfere with sensor measurements
- Protects sensors from damage during deployment or transport
- Helps limit biofouling
- Corrosion-resistant plastic material
- Threaded end for easy installation and removal



Note: The Metal Fastener secures the ports to the Flowthrough Cap's housing. It should never be removed or tampered with. Doing so may result in damage to the Flow Cap ports and cause injury to yourself or others during operation.

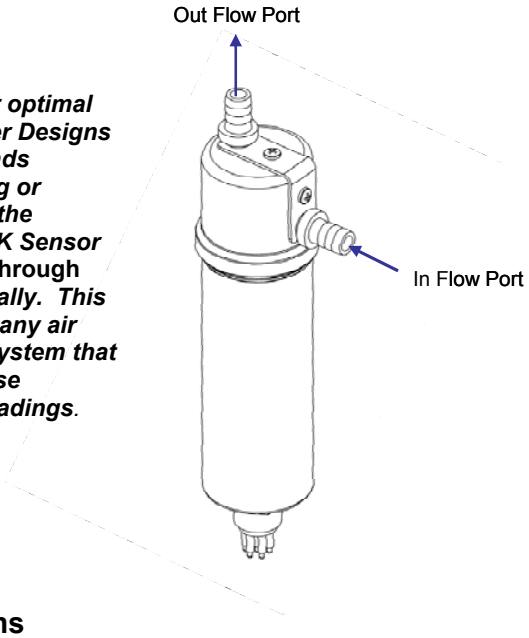
Installation

1) Turning clockwise, fully hand tighten the Flowthrough Cap housing onto the Cyclops-**6K** Sensor.



2) Flowthrough Cap installation is complete.

NOTE: For optimal use, Turner Designs recommends positioning or mounting the Cyclops-6K Sensor with* Flowthrough Cap *vertically. This will purge any air from the system that might cause skewed readings.



Specifications

Max. Pressure	50 psi
Length (w/ port)	7.1 cm (2.81 in.)
Diameter (w/ port)	7.0 cm (2.77 in.)
Weight	86.2 g (0.19 lbs.)
Max. Volume	5.00 ml
Material	Delrin

Appendix J: Installing and Using the Solid Secondary Standard

Introduction

The following information describes how to use the **Stainless or Titanium** Cyclops-7 Solid Secondary Standards:

P/N 2100-900	*In Vivo* Chlorophyll, Rhodamine WT, Fluorescein, Phycocyanin, and Phycoerythrin
P/N 2100-904	CDOM / fDOM, Crude Oil, Refined Fuels, and Optical Brighteners

Features

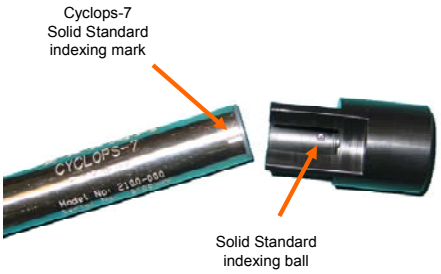
- Can be used in place of a primary liquid standard once a correlation between a primary standard and the solid standard is established.
- Can be used to check fluorometer stability and/or check for loss in sensitivity.
- Provides a broad range of very stable fluorescent responses.
- Has an adjustment screw allowing users to set to a desired signal.

Installation

1. Before installing the Solid Secondary Standard, ensure that the optical surface of the Cyclops-7 is completely clean and dry.

2. Fully mate the Solid Secondary Standard with the optical end of the Cyclops-7.

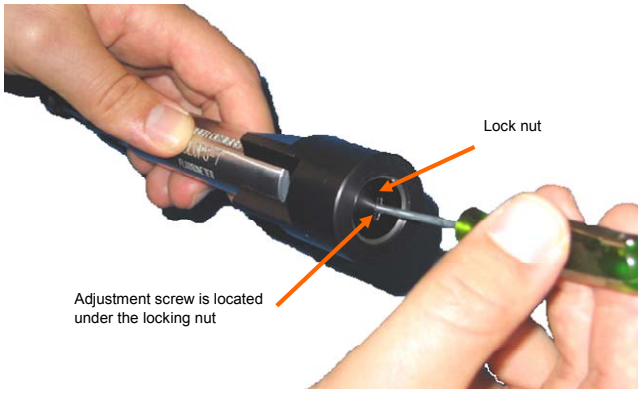
3. Rotate the Solid Secondary Standard in either direction until you feel the indexing ball click into the indexed position.



Align the index mark and indexing ball when mating the Cyclops-7 and the Solid Secondary Standard.

4. Use a flathead screwdriver to unscrew the locking nut as far as it will go.

5. To change the signal level use the green screwdriver provided and insert the blade through the hole in the locking nut. Rotate the screwdriver until it engages with the adjustment screw that is beneath the locking nut. Rotate the screw to adjust the signal level as necessary. Turning clockwise increases the signal and counterclockwise decreases the signal.



Insert the supplied green screwdriver through the hole in the locking nut to reach the adjustment screw.

6. Once the desired reading is obtained, tighten the locking nut so the adjustment screw is held firmly in place.

7. Finish by noting the output voltage and gain setting used (X1, X10 or X100) in the “Value” space on the Secondary Standard label.

8. Note that the response of every Solid Secondary Standard is unique. Hence, a new correlation must be determined for every sensor. For future identification, use the “ID” space on the label for a unique identifier for the Secondary Standard.

Specifications

Material	Delrin
Weight	45.0 g (0.099 lbs.)
Length	5.7 cm (2.25 inches)
Base Diameter	3.2 cm (1.25 inches)
A Solid Secondary Standard is not available for Turbidity Stainless or Titanium Cyclops-7 sensor.	

Use of the Solid Secondary Standard for *in vivo* Chlorophyll Applications

1. Using your Cyclops-7 Fluorometer, measure a sample containing algae and record the response and the gain values for that measurement.

2. Dry off the optical end of the Cyclops-7, attach the Solid Secondary Standard to the fluorometer, and adjust the Solid Secondary Standard to produce the same response in the same gain as in step 1.

3. Perform a chlorophyll extraction to determine the actual chlorophyll concentration of the sample.

   NOTE: EPA Method 445.0 (*in vitro* determination of chlorophyll in algae) can be found on Turner Designs' website.

4. The Solid Secondary Standard's signal is now equivalent to the concentration value determined from step 3 and can be used in place of a liquid primary standard for future calibration of that specific Cyclops-7 Fluorometer.

Use of the Solid Secondary Standard for Dye Tracing Applications

The Solid Secondary Standard can also be used to check fluorometer stability when making dye concentration measurements. If necessary, the Solid Secondary Standard can be used to establish a new correlation voltage without using a calibration solution each time.

1. Using your Cyclops-7 Fluorometer, measure a dye solution with known concentration and record the response as well as the gain values for that measurement.

2. Dry off the optical end of the Cyclops-7, attach the Solid Secondary Standard to the fluorometer, and adjust the Solid Secondary Standard to produce the same response in the same gain as in step 1.

3. The Solid Secondary Standard's signal is now equivalent to the concentration value of the dye solution used in step 1and can be used in place of a liquid primary standard for future calibration of that specific Cyclops-7.

   Note: Comprehensive information on dye trace measurements can be found at the following Turner Designs website: http://www.turnerdesigns.com/fluorescent-dye-tracing

Care and Storage

Solid Secondary Standards should be stored at room temperature (~20 °C) in their case when not in use and kept free of dust and moisture. Special care must be taken with the UV Solid Secondary Standard P/N 2100-904 to ensure that it is not exposed to UV light for prolonged periods of time. This can result in degradation of the standard.

Cyclops Submersible Sensor

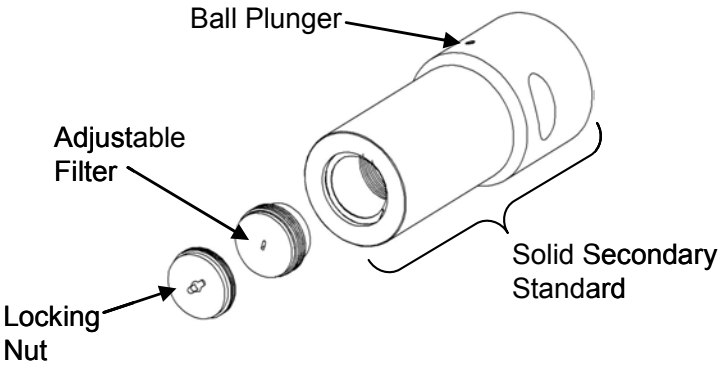
Introduction

The following information describes how to use the **Plastic** Cyclops-7 Solid Secondary Standards:

P/N 2100-908	*In Vivo* Chlorophyll, Rhodamine WT, Fluorescein, Phycocyanin, and Phycoerythrin
P/N 2100-905	CDOM / fDOM, Crude Oil, Refined Fuels, and Optical Brighteners

Features

- Can be used in place of a primary liquid standard once a correlation between a primary standard and the solid standard is established.
- Can be used to check fluorometer stability and/or check for loss in sensitivity.
- Provides a broad range of very stable fluorescent responses.
- Has an adjustment screw allowing users to set to a desired signal.

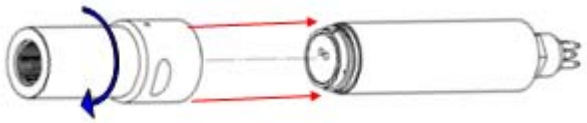


Specifications

Material	Delrin
Weight	65.9 g (0.145 lbs.)
Length	8.2 cm (3.23 inches)
Base Diameter	3.6 cm (1.42 inches)
A Solid Secondary Standard is not available for Turbidity Plastic Cyclops-7 sensor.	

Installation

1) Align Solid Secondary Standard with Plastic Cyclops-7 Sensor's optical head and snap on the Solid Standard.
2) Slightly rotate Solid Secondary Standard until it is set into position. ***Note: You will feel/hear a click when the Ball Plunger seats into position.***



3) The Solid Secondary Standard's signal is now ready to be adjusted using the green screwdriver provided.

4) Unscrew the locking nut as far as it will go.
5) Insert the green screwdriver through the hole in the locking nut and rotate until it engages with the adjustment screw on the Adjustable Filter beneath the locking nut.
6) Rotate the Adjustable Filter to adjust the reading. Turning clockwise increases the signal and counterclockwise decreases the signal.
7) Once the desired reading has been obtained, the locking nut should be screwed down to hold the Adjustable Filter firmly in place.

Note: The response of every solid secondary standard is unique. A new correlation must be determined for every sensor.

Use of the Solid Secondary Standard for *in vivo* Chlorophyll Applications

1. Using your Cyclops-7 Fluorometer, measure a sample containing algae and record the response and the gain values for that measurement.

2. Dry off the optical end of the Cyclops-7, attach the Solid Secondary Standard to the fluorometer, and adjust the Solid Secondary Standard to produce the same response in the same gain as in step 1.

3. Perform a chlorophyll extraction to determine the actual chlorophyll concentration of the sample.

   Note: EPA Method 445.0 (in vitro determination of chlorophyll in algae) can be found on Turner Designs' website.

4. The Solid Secondary Standard's signal is now equivalent to the concentration value determined from step 3 and can be used in place of a liquid primary standard for future calibration of that specific Cyclops-7 Fluorometer.

Use of the Solid Secondary Standard for Dye Tracing Applications

The Solid Secondary Standard can also be used to check fluorometer stability when making dye concentration measurements. If necessary, the Solid Secondary Standard can be used to establish a new correlation voltage without using a calibration solution each time.

1. Using your Cyclops-7 Fluorometer, measure a dye solution with known concentration and record the response as well as the gain values for that measurement.

2. Dry off the optical end of the Cyclops-7, attach the Solid Secondary Standard to the fluorometer, and adjust the Solid Secondary Standard to produce the same response in the same gain as in step 1.

3. The Solid Secondary Standard's signal is now equivalent to the concentration value of the dye solution used in step 1and can be used in place of a liquid primary standard for future calibration of that specific Cyclops-7.

   Note: Comprehensive information on dye trace measurements can be found at the following Turner Designs website: http://www.turnerdesigns.com/fluorescent-dye-tracing

Care and Storage

Solid Secondary Standards should be stored at room temperature (~20 °C) in their case when not in use and kept free of dust and moisture. Special care must be taken with the UV Solid Secondary Standard P/N 2100-905 to ensure that it is not exposed to UV light for prolonged periods of time. This can result in degradation of the standard.

Cyclops Submersible Sensor

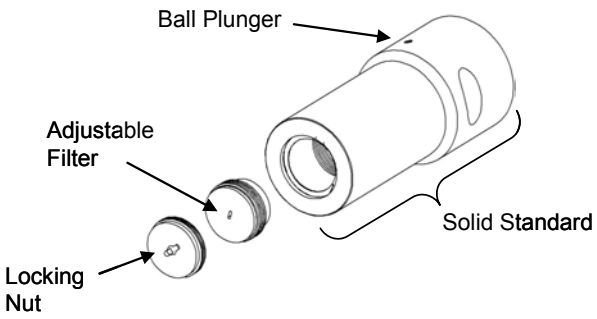
Introduction

The following information describes how to use the Cyclops-**6K** Solid Secondary Standards:

P/N 2160-900	*In Vivo* Chlorophyll, Phycocyanin, and Phycoerythrin
P/N 2160-901	CDOM / fDOM and Crude Oil

Features

- Can be used in place of a primary liquid standard once a correlation between a primary standard and the solid standard is established.
- Can be used to check fluorometer stability and/or check for loss in sensitivity.
- Provides a broad range of very stable fluorescent responses.
- Has an adjustment screw allowing users to set to a desired signal.

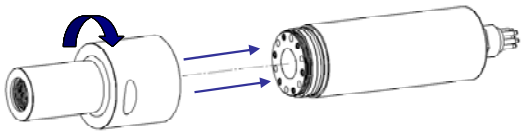


Specifications

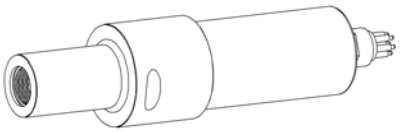
Material	Delrin
Weight	90.7 g (0.2 lbs.)
Length	9.7 cm (3.82 inches)
Base Diameter	5.2 cm (2.05 inches)

Installation

1) Align Solid Secondary Standard with Cyclops-**6K** Sensor's optical head and snap on the Solid Secondary Standard.
2) Slightly rotate Solid Secondary Standard until it is set into position. ***Note: You will feel/hear a click when the Ball Plunger seats into position.***



3) The Solid Standard's signal is now ready to be adjusted using the green screwdriver provided with the Solid Standard



4) Unscrew the locking nut as far as it will go.
5) Insert the green screwdriver through the hole in the locking nut and rotate until it engages with the adjustment screw on the Adjustable Filter beneath the locking nut.
6) Rotate the Adjustable Filter to adjust the reading. Turning clockwise increases the signal and counterclockwise decreases the signal.
7) Once the desired reading has been obtained, the locking nut should be screwed down to hold the Adjustable Filter firmly in place.

Note: The response of every solid standard is unique. A new correlation must be determined for every sensor.

Use of the Solid Secondary Standard for *in vivo* Chlorophyll Applications

1. Using your Cyclops-**6K** Fluorometer, measure a sample containing algae and record the response and the gain values for that measurement.

2. Dry off the optical end of the Cyclops-**6K**, attach the Solid Secondary Standard to the fluorometer, and adjust the Solid Secondary Standard to produce the same response in the same gain as in step 1.

3. Perform a chlorophyll extraction to determine the actual chlorophyll concentration of the sample.

   Note: EPA Method 445.0 (in vitro determination of chlorophyll in algae) can be found on Turner Designs' website.

4. The Solid Secondary Standard's signal is now equivalent to the concentration value determined from step 3 and can be used in place of a liquid primary standard for future calibration of that specific Cyclops-**6K** Fluorometer.

Care and Storage

Solid Secondary Standards should be stored at room temperature (~20 degree C) in their case when not in use and kept free of dust and moisture. Special care must be taken with the UV Solid Secondary Standard P/N 2160-901 to ensure that it is not exposed to UV light for prolonged periods of time. This can result in degradation of the standard.

Appendix K: Using the Cyclops Submersible Sensor with the DataBank

Cyclops sensors are analog output devices that produce a 0 – 5 volt signal that is proportional to the fluorophore being measured. Turner Designs offers the DataBank, a universal handheld meter, datalogger, and power supply that can be used to maximize performance of Cyclops sensors with functions such as:

- Auto gaining
- User defined calibrations
- Large internal memory
- Interval logging

The DataBank comes with intuitive GUI software that allows users to easily calibrate, set up logging, download data, and define parameters and values necessary to help configure the Cyclops for a specific application or study. Available options include GPS capability, external power, travel case, and car charger.

DataBank uses for different sampling protocols:

Multiple Site Measurements – measure fluorescence at different locations within your water system or across many systems; GPS enabled units provide latitude/longitude data per location

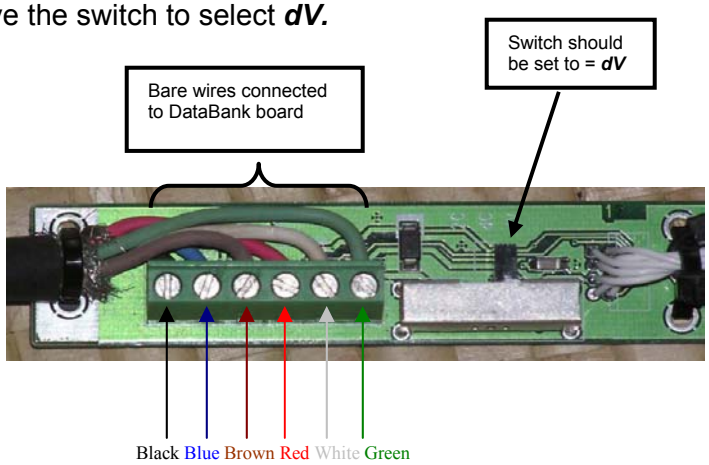
Profiling – purchase extended cables to allow for vertical profiling

Monitoring – deploy the Cyclops to a fixed location or depth and monitor the signal over time; set up logging to capture a signal within a specific time frame; download data while the sensor is deployed and continuously measuring; set up digital data output via HyperTerminal

For any application or sampling protocol, the DataBank facilitates and maximizes performance of all Cyclops sensors allowing versatility and flexibility in calibration, setup, and measurement.

Connecting the Cyclops to Turner Designs' DataBank:

Simply connect the bare wires from the Cyclops's pigtail to the DataBank board as shown below and move the switch to select ***dV.***



Appendix L: Optical Specification Guide

P/N	Application	MDL	Dynamic Range	LED (CWL)	Excitation	Emission	Sol. Std.
XXXX-000-U	CDOM / fDOM	0.15 ppb** 0.5 ppb***	0-1250 ppb** 0-5000 ppb***	365 nm	325/120 nm	470/60 nm	2100-904/905, 2160-901
XXXX-000-C	Chl *in vivo*	0.025 µg/L	0-500 µg/L	460 nm	465/170 nm	696/44 nm	2100-900/908, 2160-900
XXXX-000-F	Fluorescein Dye	0.01 ppb	0-500 ppb	460 nm	400/150 nm	545/28 nm	2100-900/908
XXXX-000-O	Oil - Crude	0.2 ppb***	0-2700 ppb ***	365 nm	325/120 nm	410-600 nm	2100-904/905, 2160-901
XXXX-000-G	Oil - Fine	2 ppb* 2 ppm****	0-10,000 ppb * >100 ppm****	285 nm	≤ 290 nm	350/55 nm	2100-904/905
XXXX-000-B	Optical Brighteners for Wastewater Treatment	0.6 ppb ***	0-15,000 ppb ***	365 nm	325/120 nm	445/15 nm	2100-904/905, 2160-901
XXXX-000-P	Phycocyanin (Freshwater Cyanobacteria)	2 ppb[PC]	0-40,000 ppb[PC]	590 nm	≤ 595 nm	≥ 630 nm	2100-900/908, 2160-900
XXXX-000-E	Phycoerythrin (Marine Cyanobacteria)	0.15 ppb[PE]	0-750 ppb[PE]	525 nm	515-547 nm	≥ 590 nm	2100-900/908, 2160-900
XXXX-000-R	Rhodamine Dye	0.01 ppb	0-1000 ppb	530 nm	535/60 nm	590-715 nm	2100-900/908
XXXX-000-T	Turbidity	0.05 NTU	0-3000 NTU	850 nm	850 nm	850 nm	N/A
XXXX-000-A	PTSA	0.1 ppb***	0-650 ppb***	365 nm	325/120 nm	405/10 nm	2100-904/905

* 1,5-Naphthalene Disulfonic Disodium Salt

** Quinine Sulfate

*** PTSA (1,3,6,8-Pyrenetetrasulfonic Acid Tetrasodium Salt)

**** BTEX (Benzene, Toluene, Ethylbenzene, Xylenes)

[PC] Phycocyanin pigment from Prozyme diluted in deionized water http://prozyme.com/

[PE] Phycoerythrin pigment from Prozyme diluted in deionized water http://prozyme.com/